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Variability of Irradiance in the Wave Boundary Layer

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LONG-TERM GOALS

Our primary goal is improve our understanding of the role of surface waves, bubble clouds, and near-surface oceanic processes on the spatial distribution of oceanic irradiance.

SCIENTIFIC OBJECTIVES

The objectives are to:

- Measure the variance in the oceanic light field?
- Associate the variance in the light field with surface waves and variance in the inherent optical properties?

APPROACH

This program has been in the planning stage for the past year. The approach we plan to implement in the field program is to make spatial measurements of physical (near surface T, C, turbulence levels, surface wave heights), and optical (a, c, bb, Ed) fields from sensors mounted on OSU's AUV (Figure 1) By measuring the irradiance field at high frequency we will be able to provide the optical measurements needed to evaluate models of surface effects on the irradiance field (e.g., Zaneveld et al. 2001). The optical measurements will be combined with physical measurements to improve physical models associated with surface slopes and bubble injection.

To achieve high-resolution irradiance measurements we integrated two Biospherical single wavelength irradiance sensors into the MicroSoar microstructure sensor. This sensor has the high sampling rate that is needed to achieve small, spatial-scale irradiance measurements. At the normal operating speed of the AUV (~2 m/s) irradiance measurements at 200 Hz will provide cm-scale spatial resolution. The

MicroSoar currently has a high-frequency turbidity probe that can provide information on the small scale distribution of particles. Measurements of bulk absorption and attenuation coefficients will be made using an ac-9 with water pumped to the instrument from the nose of the vehicle. Measurements of the backscattering coefficient and spectral irradiance will be collected with instruments penetrating the hull of the AUV.



Figure 1. The Odyssey III AUV with the payload section open. The irradiance sensor is visible at the top and the ac-9 is being serviced.

The AUV will be flown along several isobars to measure the light field, IOPs and physical properties. Along each isobar it is possible to determine the power spectrum of irradiance fluctuations and provide other statistics related to the variability in the light field. These statistics can then be compared to the variability in modeled light fields.

Near the surface we expect bubbles to be an important factor affecting irradiance on windy days. Separating the bubbles from other materials in the water can be accomplished using either acoustics or optics or both. We are proposed to use a pair of WET Labs VSF instruments to measure scattered light at angles on either side of the jump in the scattering function for bubbles (Stramski and Tegowski, 2001). This will allow us to identify bubbles outside the volume of the AUV without possible modification to bubbles in a flow-through system.

We have been working with Marlon Lewis's group to integrate their radiance sensor into the AUV. The integration of the radiance sensors will allow for co-located measurements of a large suite of

inherent optical and radiometric properties. We anticipate that the AUV will be used to make spatial observations near an optical-mooring in order to place AUV-measurements in space-time context. Atmospheric meteorological measurements including wind speed, direction, surface heat fluxes, and radiance can be obtained from sensors mounted on the ship. Observations will be made available for the modeling community to test and validate radiance-based RT models in conjunction with surface-wave models.

WORK COMPLETED

We integrated a new pressure sensor into the AUV to allow it to have better depth control for shallow water transects. We purchased two irradiance sensors and integrated them into the Microsoar and AUV. We worked with Marlon Lewis's group to set up the AUV to accept their radiance detector. We continue to attend field planning meetings to confirm the ship capabilities and arrange field exercises.

RESULTS

None to report.

IMPACT/APPLICATIONS

None

RELATED PROJECTS

Other projects participating in the RaDyO program. <http://www.opl.ucsb.edu/radyo/>

REFERENCES

Stramski, D., and J. Tegowski, Effects of intermittent entrainment of air bubbles by breaking wind waves on ocean reflectance and underwater light field. J. Geophys. Res., 106, 31,345-31,360. 2001.

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